§ 18. For C (the coefficient of the periodic inequalities) and P we find $r = 0{\cdot}30 \pm 0{\cdot}10$, which is not so conclusive. The relation would be

$$C = 7{\cdot}3 + {\cdot}064P.$$

§§ 19–29. Examination of 8 stars in detail, for which special information was available. The result is favourable. Remarks on S Serpentis, which seems to be exceptional.

§ 30. List of stars needing special attention.

§ 31. The type of light curve seems to be independent of C and A.

§§ 32–34. Possibility of a single periodic cause affecting all stars considered, but not supported.

Note on the Period of S Serpentis. By H. H. Turner, D.Sc., F.R.S., Savilian Professor.

1. The formula given for the maxima of S Serpentis (No. 5501) by Chandler in his Revision of the 3rd Catalogue (*A.J.*, No. 553) is

$$2388724 + 368{\cdot}5\ E + 116 \sin (4^{\circ}\ E + 62^{\circ}).$$

The periodic term in this formula attracted attention by considerable divergence from the value suggested by the preceding paper. The coefficient 116 days is much too large, and the argument 4° E is too small. With a view to seeing whether it was well established, or whether perhaps some other formula would fit the observations, inquiry was made of Professor Müller, of Potsdam, who very kindly sent a complete list of observed maxima, with full references; adding a comparison with Chandler's formula, the remark that it did not fit more recent observations, and a suggestion of his own for improving it, which modified both the coefficient 116 and the argument 4° E in the right direction. But this suggestion does not fit the observation of Lalande, and reasons will be given below why it is probably too early to suggest a completely satisfactory formula, in spite of the fact that Lalande's observation was made in 1794. Hence it seems unnecessary to reproduce here the full details, which will doubtless appear in the great work of reference for variable stars now being prepared by the German Committee of which Dr. Müller is a member.

2. For our present purpose the observations are sufficiently represented by the dates for every fifth maximum shown in the second column of Table I. The numeration in the first column is that of Chandler. In the third column are given the intervals, and we have to decide how to interpret Lalande's observation, which may belong to any one of the epochs -35, -34, or -33. Chandler takes -33; and this gives an average interval of 1876 days for 5 periods, extending over 7×5 periods in all. This was quite a possible interpretation before the modern observations (represented

by epoch 76) were made. Up to epoch 71 the interval was increasing, and might have gone on doing so. But later observations have made this interpretation impossible. The maximum interval is clearly past at epoch 71. We have only a single entry in the table to prove this, but the entry stands for 5 well-determined maxima in which 5 separate observers were concerned: 3 of them observed epoch 74, 2 of them epoch 75, and epochs 76, 77, 78 were all observed. The mean errors of Chandler's formula are −20, −31, −27, −44, −43 days; and it seems clear that the formula no longer holds.

Table I.

E.	Max.	Int.	A+365·1 E.	·080×(E−36)².	O−C$_1$.	−40 sin. (7°·2 E+281°).	O−C$_2$.
−35	2376442		2376018	403	+21	−24	−3
or −34		7(1772)	383	392			
or −33		or 7(1824)	748	381			
		or 7(1876)					
1	2389210		2389161	98	−49	+38	−11
6	—	3(1835)	—	—	—	—	
11	—		—	—	—	—	
16	2394714		2394638	32	+44	−24	+20
		1813					
21	6527		6463	18	+46	−38	+8
		1807					
26	8334		8289	8	+37	−38	−1
		1798					
31	2400132		2400114	2	+16	−24	−8
		1802					
36	1934		1940	0	−6	0	−6
		1809					
41	3743		3765	2	−24	+24	0
		1818					
46	5561		5591	8	−38	+38	0
		1834					
51	7395		7416	18	−39	+38	−1
		1853					
56	9248		9242	32	−26	+24	−2
		1874					
61	2411122		2411067	50	+5	0	+5
		1860					
66	2982		2893	72	+17	−24	−7
		1873					
71	4855		4718	98	+39	−38	+1
		1854					
76	6709		6544	128	+37	−38	−1
81	(to come)		8369	162		−24	
86	(,,)		2420195	200		0	

On the other hand, if we alter Lalande's observation by one whole period, we get an average interval of 1824 days for 5 periods. This means that a maximum interval occurs between epoch 1 and 16, where the average value is 1835 days. But this maximum is much less than that between epochs 61 and 76, where the average value is 1869 days.

3. The conclusion seems to be that we cannot satisfy the observations by a *single* inequality, however we choose the coefficient and argument, if Lalande's observation is to be accepted. But this is, after all, no new thing. Chandler gives several cases of the kind, and others may be found in the future. For instance, he gives for R Hydræ (No. 4826),

$$2411931{\cdot}0 + 425{\cdot}15\ \mathrm{E} - 0{\cdot}36\ \mathrm{E}^2 + 15 \sin (7^\circ{\cdot}5\ \mathrm{E} + 202^\circ).$$

If we admit an additional term in E^2 (which means that the period is changing steadily), we can fairly satisfy the observations. The approximate value of the coefficient of E^2 is indicated by the fact just quoted, viz. that the average interval near the maximum at epoch 9 is 1835 days (average period 367 days), while that at epoch 69 is 1869 days (average period 374 days). Thus the period changes 7 days in 60 periods, or the coefficient of E^2 is about ·06.

4. But anyone who has had experience of such work knows that such rough approximations are followed by a series of "trials and errors"; and by experiment a better value for the coefficient was found to be ·080, as indicated in the fifth column of Table I. The accompanying value of the period (for E=36) is 365·1 days; and starting with an arbitrary epoch, this is represented in the fourth column.

5. The values of O—C are shown in the sixth column, from which it is seen that an inequality of much shorter period than Chandler's will satisfy them approximately if Lalande's observation be referred, not to E = −33 or even E = −34, but to E = −35. The numerical values assumed are

$$+40 \sin (7^\circ{\cdot}2\ \mathrm{E} + 281^\circ),$$

which are in much better agreement with the values assigned by the correlation formulæ of the preceding paper, viz.

$$+30 \sin (9^\circ{\cdot}0\ \mathrm{E} + ?),$$

than Chandler's expression,

$$116 \sin (4^\circ\ \mathrm{E} + 62^\circ).$$

6. The final residuals are shown in the column $O—C_2$. We must wait for confirmation of the considerable assumption already made; and to this end the maxima ensuing in the next few years are predicted as—

	J.D.	
79	241 7817	= 1907 Aug. 29
80	241 8186	1908 Sept. 1
81	241 8555	1909 Sept. 5
82	241 8923	1910 Sept. 8
83	241 9291	1911 Sept. 11
84	241 9659	1912 Sept. 13
85	242 0027	1913 Sept. 16
86	242 0395	1914 Sept. 19

7. The complete formula is thus—

$$2388796 + 365{\cdot}1\ \mathrm{E} + {\cdot}080\ (\mathrm{E} - 36)^2 + 40 \sin (7^\circ{\cdot}2\mathrm{E} + 281^\circ)$$
$$= 2388900 + 359{\cdot}3\ \mathrm{E} + {\cdot}080\ \mathrm{E}^2 + 40 \sin (7^\circ{\cdot}2\ \mathrm{E} + 281^\circ);$$

but the term ·080 E^2 is of a provisional character, and probably represents the present value of a term of long period.

8. The main interest of this inquiry is the result that even in such an exceptional case as that of S Serpentis it is found possible to obtain fair accordance with the suggested formula by a simple supposition of a kind already familiar in other cases; while it seems certain that the discrepant formula is not correct. Possibly in other cases of discordance similar explanations may be found.

On the Orbit of β 416. By J. Voûte.

(*Communicated by W. Bowyer.*)

The periods calculated for this interesting binary differ very much. The last, that of Doberck, with a period of forty-six years, was based on the measures up to 1903, and his ephemeris gives, with the recent observations, nearly constant negative differences. In the present instance the measures published up to 1906 have been used. In the first place, all the position-angles and distances are brought up to the epoch 1910·0; then 6 normal-places are formed with position-angles and distances. These normal-places are formed out of the groups marked by square brackets. First a normal-place is formed for every year with weights equal to the number of nights observed by the different observers, and then the normal-place of a group with weights equal to the number of years.

Normal-places.

	°	″		°	″
1877·23	228·77	1·79	1898·14	305·37	1·85
1889·89	129·19	0·98	1901·77	291·35	2·11
1895·80	322·14	1·34	1905·60	280·08	2·21